What is claimed is:

1. A magnetoresistive random-access memory device comprising a p-i-n type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode which includes a p-type half-metallic ferromagnetic semiconductor, an n-type half-metallic ferromagnetic semiconductor and at least one atomic layer of nonmagnetic insulator (i-layer) interposed therebetween, said diode having a rectification effect so as to provide a TMR element with a switching function based on said rectification effect.

2. A magnetoresistive random-access memory device comprising a p-type half-metallic ferromagnetic semiconductor and an n-type half-metallic ferromagnetic semiconductor which are joined together to create a p-n junction type low-resistance tunneling-magnetoresistance effect (low-resistance TMR) so as to provide a TMR element with a switching function based on a rectification effect.

3. A magnetoresistive random-access memory device comprising a p-type half-metallic ferromagnetic semiconductor formed by doping Cr and a hole in a group II-VI compound semiconductor, and an n-type half-metallic ferromagnetic semiconductor formed by doping V and an electron in said group II-VI compound semiconductor, which are joined together to form a p-n junction type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode having a rectification effect so as to provide a TMR element with a switching function based on said rectification effect.

4. A magnetoresistive random-access memory device comprising a p-type half-metallic ferromagnetic semiconductor formed by doping Mn and a hole in a group III-V compound semiconductor, and an n-type half-metallic ferromagnetic semiconductor formed by doping Cr and an electron in said group III-V compound semiconductor, which are joined together to form a p-n junction type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode having a rectification effect so as to provide a TMR element with a switching function

based on said rectification effect.

5. A magnetoresistive random-access memory device comprising a p-i-n type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode which includes a p-type half-metallic ferromagnetic semiconductor formed by doping Cr and a hole in a group II-VI compound semiconductor, an n-type half-metallic ferromagnetic semiconductor formed by doping V and an electron in said group II-VI compound semiconductor, and at least one atomic layer of nonmagnetic insulator (i-layer) interposed therebetween, said diode having a rectification effect so as to provide a TMR element with a switching function based on said rectification effect.

6. A magnetoresistive random-access memory device comprising a p-i-n type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode which includes a p-type half-metallic ferromagnetic semiconductor formed by doping Mn and a hole in a group III-V compound semiconductor, an n-type half-metallic ferromagnetic semiconductor formed by doping Cr and an electron in said group III-V compound semiconductor, and at least one atomic layer of nonmagnetic insulator (i-layer) interposed therebetween, said diode having a rectification effect so as to provide a TMR element with a switching function based on said rectification effect.

7. A magnetoresistive random-access memory device comprising a p-i-n type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode which includes a p-type half-metallic ferromagnetic semiconductor formed of ZnO doped with Cr and a hole, an n-type half-metallic ferromagnetic semiconductor formed of ZnO doped with an electron and either one selected from the group consisting of V, Fe, Co and Ni, and at least one atomic layer of nonmagnetic insulator (i-layer) interposed therebetween, said diode having a rectification effect so as to provide a TMR element with a switching function based on said rectification effect.

8. A magnetoresistive random-access memory device comprising a p-type half-metallic

ferromagnetic semiconductor formed of ZnO doped with Cr and a hole, and an n-type half-metallic ferromagnetic semiconductor formed of ZnO doped with an electron and either one selected from the group consisting of V, Fe, Co and Ni, which are joined together to form a p-n junction type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode having a rectification effect so as to provide a TMR element with a switching function based on said rectification effect.

9. A magnetoresistive random-access memory device comprising a p-i-n type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode which includes a p-type half-metallic ferromagnetic semiconductor formed by doping Fe and a hole in a group IV semiconductor, an n-type half-metallic ferromagnetic semiconductor formed by doping Mn and an electron in said group IV semiconductor, and at least one atomic layer of nonmagnetic insulator (i-layer) interposed therebetween, said diode having a rectification effect so as to provide a TMR element with a switching function based on said rectification effect.

10. A magnetoresistive random-access memory device comprising a p-type half-metallic ferromagnetic semiconductor formed by doping Fe and a hole in a substitution position of a group IV semiconductor, and an n-type half-metallic ferromagnetic semiconductor formed by doping Mn and an electron in said group IV semiconductor, which are joined together to form a p-n junction type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode having a rectification effect so as to provide a TMR element with a switching function based on said rectification effect.

11. A magnetoresistive random-access memory device comprising a p-type half-metallic ferromagnetic semiconductor formed by doping Mn and a hole in an interstitial position of a group IV semiconductor, and an n-type half-metallic ferromagnetic semiconductor formed by doping Cr and an electron in said group IV semiconductor, which are joined together to form a p-n junction type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode having a rectification effect so as to provide a TMR element with a switching function based on

said rectification effect.

12. A method for producing the magnetoresistive random-access memory device using the group III-V compound semiconductor-based half-metallic ferromagnetic semiconductors to provide a TMR element with a switching function based on a rectification effect of the p-i-n type or p-n type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode, as defined in either one of claims 1 to 11, said method comprising changing the concentration of 3d, 4d and 5d transition metal impurities or a rare-earth impurity, or the concentration of a hole and electron, to control a ferromagnetic transition temperature of the ferromagnetic semiconductor constituting said TMR element.

13. A method for producing the magnetoresistive random-access memory device using the group II-VI compound semiconductor-based half-metallic ferromagnetic semiconductors to provide a TMR element with a switching function based on a rectification effect of the p-i-n type or p-n type low-resistance tunneling-magnetoresistance-effect (low-resistance TMR) diode, as defined in either one of claims 1 to 11, said method comprising changing the concentration of 3d, 4d and 5d transition metal impurities or a rare-earth impurity, or the concentration of a hole and electron, to control a ferromagnetic transition temperature of the ferromagnetic semiconductor constituting said TMR element at a desired value.